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COMPARATIVE SHRINKAGE IN WEIGHT OF ALFALFA CURED WITH LEAVES ATTACHED AND REMOVED

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INTRODUCTION

There is a rather prevalent opinion, and one that has frequently found expression in agricultural literature, that forage crops cure more quickly if handled in such a way as to maintain the leaves in as fresh a condition as possible until enough time has elapsed to permit the stems to lose much or most of their moisture. This view is well expressed in the following citations:

In growing plants there is a constant stream of water entering the roots, carrying plant food through the plant to the leaves, where the water is thrown off by transpiration. When the plant is cut off, as in the case of hay plants, the leaves, if kept alive, will continue to transpire or pump the water from the plant until a large per cent of it has evaporated.—McClure (4, p. 6).²

Proper slow curing enables the moisture to be drawn from the stems into the leaves and off from their surfaces. * * *.—Mohler (5, p. 243).

If the hay is raked before the leaves are dry and placed in cocks, the leaves continue to pump water out of the stems, thus allowing the hay to cure out fully and evenly.—(2, p. 242).

On the other hand, if the mowing is done late in the afternoon or during cloudy weather, much of the moisture in the stems passes out through the leaves * * *.—Carrier (1, p. 2527).

Therefore, while the leaf has yet pliancy and some semblance of its natural condition, it is most efficiently carrying away the sap of the stem * * *.—Wing (10, p. 309).

There is serious doubt as to the accuracy of the theory that the leaves of the cut plants act as pumps.—Piper and others (7, p. 331).

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² Reference is made by number (italic) to "Literature cited," p. 10.

If the hay is raked into windrows as soon as the leaves are well wilted and then put into tall, narrow shocks and allowed to cure out slowly and thoroughly so that the leaves will be kept alive to give off the moisture of the stems by transpiration, the farmer can more easily determine when the hay is thoroughly cured than if curing is done mostly in the swath or windrow.—McClure (3, p. 10).

As soon as the plants are cut the leaves lose water and draw on the stems for more. * * * If they dry too fast * * * the leaves are killed prematurely; they stop pumping water out of the stems * * *.—Pieters (6, p. 11).

After the plants are cut, while the leaves are wilted but before they are too dry, the leaves draw moisture from the stems of the plant. As soon as the leaves become dry they cease drawing moisture from the stem.—Waldron (9, p. 370).

If hay is raked into the windrows after partially curing in the swath but before any of the leaves have become dry, a large proportion of the hay will be protected from the direct rays of the sun and the curing will take place evenly by transpiration of water from the leaves.—Roberts and Kinney (8, p. 15).

It is partly on the assumption that leaves do continue to pump moisture from stems even after the plants are cut that curing in the windrow or cock has been so commonly advocated. It is generally recognized that hay cured in this way retains more of its leaves, thereby increasing its feeding value, but so far as can be ascertained no experiments have been conducted to determine whether any appreciable quantity of water passes off from the stems through the leaves after a crop is harvested.

With this in mind, some simple tests were begun in 1924 and continued in 1925. These tests were conducted at Redfield, S. Dak., Bard, Calif., Rosslyn, Va., near Washington, D. C., and North Ridgeville, Ohio. Samples of alfalfa were taken and weighed immediately. One or more of these were left to cure in the natural condition—that is, with the leaves on—while the leaves were picked from others by hand. Weights of the various lots were taken at the same time in all cases, but the intervals between the weighing periods were more or less irregular. The weighings were continued until the weights had become stationary or practically so.

TESTS AT REDFIELD, S. DAK.

The most extensive and complete tests along this line were conducted at the Redfield field station, Redfield, S. Dak., in 1925. Tests were made in triplicate, the various samples being allowed to dry in the seed house. Three 100-gram samples were cured in the natural condition; that is, with the leaves attached to the stems. From three other 100-gram lots the leaves with the petioles were picked by hand as quickly as possible, after which the stems and leaves were weighed separately. Leaves were picked off other lots at the end of 4, 7½, 25, 31½, 48½ hours and daily thereafter with one exception. Up to the time the leaves were removed the various samples had been allowed to cure in the natural condition. Subsequent to the initial weighing the stems and leaves were weighed separately. As plants lose moisture most rapidly during the first few hours after cutting, weights were taken at rather short intervals the first day, twice the second day, and once every 24 hours thereafter. These losses, which in all cases are the averages of three samples, are shown in Tables 1 and 2.

In Table 1, column 1 shows the percentage losses in alfalfa cured with the leaves attached, whereas column 2 shows percentage losses with leaves removed. In all other columns the first figures (those in italics)

represent percentage losses in the weight of samples allowed to cure with the leaves attached up to the time shown, while subsequent figures represent percentage losses with leaves removed. After the leaves were removed the stems and leaves were weighed separately, but the weights have been combined for the computations in this table.

TABLE 1.—*Comparative losses in weight of alfalfa in process of curing, with leaves attached and with leaves removed, at Redfield, S. Dak., in 1925*

[The original weight of each sample with leaves attached was 100 grams. Each result is the average of three samples. Losses in weight with leaves attached are shown in italic figures]

Time from beginning of test	Loss in weight by evaporation (per cent)									
	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6	Lot 7	Lot 8	Lot 9	Lot 10
1½ hours.....	6.1	7.8								
4 hours.....	14.7	19.7	16.9							
7½ hours.....	29.7	33.3	33.1	29.3						
25 hours.....	52.9	54.5	53.8	56.6	53.0					
31½ hours.....	53.2	59.7	59.4	61.9	61.1	57.4				
48½ hours.....	62.8	63.5	62.6	65.1	64.9	63.7	64.4			
72 hours.....	66.3	67.2	67.0	68.9	69.1	67.8	68.0	66.4		
96 hours.....	69.0	69.2	69.0	70.9	70.7	70.0	70.5	70.3	69.3	
120 hours.....	70.3	71.0	70.2	71.9	72.2	71.7	71.8	71.7	71.1	69.6
168 hours.....	70.5	70.2	69.6	71.0	71.3	70.9	70.2	70.9	70.3	69.9
192 hours.....	70.0	68.4	67.7	69.6	70.1	69.8	69.8	70.3	69.4	69.2
216 hours.....	71.1	71.3	70.3	71.8	72.4	71.9	71.6	72.0	71.1	71.1
240 hours.....	71.1	71.1	70.2	71.7	72.3	71.8	71.5	72.1	71.5	71.2
456 hours.....	70.3	69.9	68.9	70.8	71.4	70.9	70.4	71.0	70.1	70.2

In comparing the data in the first two columns of Table 1 it is found that during the first 120 hours the losses were consistently somewhat greater where the leaves had been removed from the stems. After this time the weights were practically stationary, except for minor fluctuations. Lot 3, from which the leaves were removed at the end of 4 hours, had lost less moisture up to this time than lot 2, from which the leaves were removed at the beginning of the experiment. During the remainder of the test, however, lots 2 and 3 lost moisture very uniformly. At the end of seven and one-half hours, when the leaves were picked from lot 4, it weighed almost the same as lot 1 with the leaves attached, but had lost less in weight than the two lots from which the leaves had been removed previously. Up to the time the leaves were removed from lots 5, 6, 8, and 10 they had lost moisture less rapidly than lots from which the leaves had previously been removed. Lots 7 and 9, on the other hand, had lost slightly more moisture up to the time the leaves were removed than some of the lots from which the leaves had been removed previously. In all cases the rate at which the various lots lost moisture was very uniform so long as the leaves were attached to the stems. The same thing holds true for the lots with leaves detached, the variation in rate at which the various lots lost moisture seldom exceeding 2 per cent. As a whole, the losses were somewhat more rapid where the leaves were removed from the stems than where they were attached. This difference is so slight, however, that it is believed to be due in part at least to losses that occurred in handling.

Table 2 shows the shrinkage in weights of alfalfa stems alone, as indicated by the actual weights in grams. The weights shown in italics were taken immediately after the leaves were removed. Here again

the figures given are the averages of three samples which originally weighed 100 grams each with leaves attached. In comparing lots 2 and 3 it is seen that lot 2, from which the leaves had been removed two and one-half hours before they were removed from lot 3, had lost just about the same in weight. The stems of lot 4 at the time the leaves were detached had lost practically the same as lots 2 and 3, from which the leaves had been previously removed. Lot 5 seemed to have lost weight slightly less rapidly than the other lots. Lots 6, 7, 8, 9, and 10 at the time the leaves were removed had lost moisture at about the same rate as the various lots from which the leaves had been removed from time to time. In some cases the losses were a little more rapid and in other cases a little less rapid with the leaves attached. However, such differences as occur fall easily within the limits of experimental error.

TABLE 2.—*Shrinkage in weight of alfalfa stems and leaves, each cured alone, at Redfield, S. Dak., in 1925*

[The original weight of each sample with leaves attached was 100 grams. Each result is the average of three samples. Weights taken immediately after leaves were removed are shown in italic figures]

Time from beginning of test	Weight at intervals during the process of curing (grams)																			
	Stems										Leaves									
	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6	Lot 7	Lot 8	Lot 9	Lot 10	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6	Lot 7	Lot 8	Lot 9	Lot 10	Lot 2	Lot 3
1½ hours.....	46.2									45.9										
4 hours.....	40.2	39.6								40.2	37.6									
7½ hours.....	33.6	34.3	33.4							33.1	32.6	30.8								
25 hours.....	24.6	25.0	24.1	26.4						20.9	21.2	19.4	18.8							
31½ hours.....	22.2	22.7	21.6	23.2	23.4					17.4	17.9	16.5	15.7	16.6						
48½ hours.....	21.1	21.1	19.7	21.0	21.3	21.3				15.5	16.3	15.2	14.1	15.0	14.1					
72 hours.....	18.3	18.0	16.9	17.5	18.0	18.0	19.1			14.5	15.0	14.3	13.4	14.2	14.1	13.9				
96 hours.....	16.4	16.2	15.1	15.6	15.9	15.7	15.9	15.9		14.4	14.8	14.0	13.6	14.1	13.7	13.9	14.3			
120 hours.....	15.0	15.4	14.4	14.5	14.7	14.7	14.8	14.9	15.4	14.0	14.4	13.6	13.3	13.6	13.5	13.5	14.0	14.1		
168 hours.....	15.4	15.8	14.8	15.1	15.0	15.6	15.2	15.3	15.7	14.4	14.5	14.2	13.6	14.2	14.3	13.9	14.4	14.5		
192 hours.....	16.2	16.7	15.6	15.8	15.3	15.8	15.5	15.5	15.9	15.4	15.6	14.9	14.1	14.9	14.4	14.2	15.1	14.9		
216 hours.....	14.8	15.3	14.4	14.4	14.3	14.8	14.6	14.8	14.9	13.8	14.4	13.8	13.2	13.7	13.6	13.3	14.1	13.9		
240 hours.....	14.9	15.4	14.5	14.3	14.4	14.8	14.5	14.7	14.8	13.9	14.4	13.8	13.4	13.8	13.7	13.4	13.8	14.0		
456 hours.....	15.7	16.1	15.0	14.9	14.8	15.4	15.2	15.3	15.3	14.4	15.0	14.2	13.7	14.3	14.2	13.8	14.6	14.4		

Table 2 also shows the shrinkage in weights of leaves alone, as indicated by the actual weights in grams taken at more or less frequent intervals. The italicized weights were taken immediately after the leaves were removed from the stems. There is no way of determining the actual weight of the leaves before they were removed from the stems, but the material was very uniform, and as the results in all cases are the averages of three samples it would seem that the figures should be fairly comparable. In comparing lots 2 and 3 it is seen that the leaves from lot 3, which had cured up to this time on the stems, had lost more rapidly than leaves from lot 2, which had been removed about two and one-half hours previously. Similar results were shown in lots 4, 5, 6, 7, and 8, where for the most part the weight of the leaves immediately after they were removed from the stems was somewhat less than for any of the lots where the leaves had been previously removed at times of varying lengths. In general, the leaves from lots 9 and 10 weighed slightly more when removed than those lots from which the leaves had been removed 4 or 5 days earlier. At this

time, however, the total weights had become almost stationary, indicating that the alfalfa had reached the air-dry stage. In most cases the weights of leaves immediately after their removal from the stems were somewhat less than where leaves had been removed several hours earlier. These differences are not great enough to be significant except in so far as they indicate that little or no moisture escaped from the stems through the leaves in curing, otherwise they would have carried more moisture at the time they were removed from the stems than lot 2, for example, the leaves of which had been detached from the stems at the beginning of the experiment.

The data presented in Table 2 indicate pretty clearly that the leaves were of no material assistance in hastening the curing. As a matter of fact the loss in weight in most cases was slightly more rapid where the leaves were removed from the stems. Just how much of this difference may be attributed to losses entailed in handling the samples is hard to say, though it certainly could not have amounted to much.

It is interesting to note that the weights of the leaves and the stems at the beginning of the experiment and after they lost no further moisture were practically equal in the several lots. In the meantime the leaves lost moisture appreciably more rapidly than the stems. This is well illustrated in Table 3.

TABLE 3.—*Comparative weights of stems and leaves of alfalfa in process of curing at Redfield, S. Dak., in 1925*

[The original weight of each sample with leaves attached was 100 grams. Each result is the average of three samples, expressed in grams]

Time from beginning of test	Lot 2		Lot 3		Lot 4		Lot 5		Lot 6		Lot 7		Lot 8	
	Stems	Leaves	Stems	Leaves	Stems	Leaves	Stems	Leaves	Stems	Leaves	Stems	Leaves	Stems	Leaves
1½ hours.....	46.2	45.9												
4 hours.....	40.2	40.2	39.6	37.6										
7½ hours.....	33.6	33.1	34.3	32.6	33.4	30.8								
25 hours.....	24.6	20.9	25.0	21.2	24.1	19.4	26.4	18.8						
31½ hours.....	22.2	17.4	22.7	17.9	21.6	16.5	23.2	15.7	23.4	16.5				
48½ hours.....	21.1	15.5	21.1	16.3	19.7	15.2	21.0	14.1	21.3	15.0	21.3	14.1		
72 hours.....	18.3	14.5	18.0	15.0	16.9	14.3	17.5	13.4	18.0	14.2	18.0	14.1	19.1	13.9
96 hours.....	16.4	14.4	16.2	14.8	15.1	14.0	15.6	13.6	15.9	14.1	15.7	13.7	15.9	13.9
120 hours.....	15.0	14.0	15.4	14.4	14.4	13.6	14.5	13.3	14.7	13.6	14.7	13.5	14.8	13.5
168 hours.....	15.4	14.4	15.8	14.5	14.8	14.2	15.1	13.6	15.0	14.2	15.6	14.3	15.2	13.9
192 hours.....	16.2	15.4	16.7	15.6	15.6	14.9	15.8	14.1	15.3	14.9	15.8	14.4	15.5	14.2
216 hours.....	14.8	13.8	15.3	14.4	14.4	13.8	14.4	13.2	14.3	13.7	14.8	13.6	14.6	13.3
240 hours.....	14.9	13.9	15.4	14.4	14.5	13.8	14.3	13.4	14.4	13.8	14.8	13.7	14.5	13.4
456 hours.....	15.7	14.4	16.1	15.0	15.0	14.2	14.9	13.7	14.8	14.3	15.4	14.2	15.2	13.8

At Redfield, S. Dak., 100-gram samples of alfalfa taken just as the plants were coming into bloom were weighed on August 13, 1924. Unfortunately, the records for the first three days were lost, but the data for the remainder of the test appear to be of sufficient value to warrant publication and are given in Table 4.

As shown by Table 4, samples of alfalfa with leaves removed from the stems lost moisture with appreciably greater rapidity than where the leaves were left on the stems. This test included a little variation from the experiment previously reported, in that the leaves were detached from two lots. In one lot the stems and leaves were mixed in curing, and in the other lot they were cured separately, but as the two lost moisture at approximately the same rate the average of the results has been reported in the table.

TABLE 4.—*Losses in weight of 100-gram samples of alfalfa in process of curing with leaves attached and with leaves removed, at Redfield, S. Dak., in August, 1924*

[The records of weights for the first three days were lost]

Time from beginning of test	Loss in weight by evaporation (per cent)		Time from beginning of test	Loss in weight by evaporation (per cent)	
	Leaves attached (average of 2 samples)	Leaves removed (average of 4 samples)		Leaves attached (average of 2 samples)	Leaves removed (average of 4 samples)
96 hours.....	53.25	61.75	219 hours.....	69.0	71.0
120 hours.....	61.0	66.9	243 hours.....	69.37	71.1
144 hours.....	63.5	68.0	267 hours.....	69.88	71.4
171 hours.....	66.25	70.0	292 hours.....	70.37	-----
195 hours.....	67.75	70.4			

A second test was begun August 17, 1924, at the Redfield field station. The results are reported in Table 5. In the weights here reported the petioles are included with the leaves. In certain other tests the leaflets only were removed, leaving the petioles attached to the stems, but since the comparative shrinkage in weights showed no material difference the figures have not been included in this table.

TABLE 5.—*Comparative losses in weight of 100-gram samples of alfalfa in process of curing with leaves attached and with leaves removed, at Redfield, S. Dak., in test begun August 17, 1924*

Time from beginning of test	Loss in weight by evaporation (per cent)				Time from beginning of test	Loss in weight by evaporation (per cent)			
	Leaves attached	Average of two samples				Leaves attached	Average of two samples		
		Leaves removed	Stems only	Leaves only			Leaves removed	Stems only	Leaves only
20 hours.....	22.0	25.0	17.7	25.6	119 hours.....	68.0	71.25	68.0	72.3
47 hours.....	46.0	51.5	47.3	51.45	143 hours.....	70.5	72.5	70.5	72.3
71 hours.....	56.5	61.75	55.6	61.9	167 hours.....	72.75	75.50	75.4	74.35
95 hours.....	63.5	67.87	62.4	70.75					

Here again the samples with leaves detached lost moisture more rapidly than when they were allowed to cure in the natural condition, and as might be expected the stems lost moisture less rapidly than the leaves, though the two finally reached about the same weight.

On July 29, 1924, three 3-pound samples of alfalfa were taken at Redfield, S. Dak. One sample was left to cure with the leaves on, but the leaves were removed from each of the other samples, one lot being allowed to cure with the leaves and stems mixed and the other lot with the leaves and stems separated. Unfortunately, no weights were taken the first four days, but the results obtained after that time are given in Table 6, since they conform closely to the results obtained with the smaller lots.

TABLE 6.—*Comparative losses in weight of 3-pound samples of alfalfa in process of curing with leaves attached and with leaves removed, at Redfield, S. Dak., in July, 1924*

Time from begin- ning of test	Loss in weight by evaporation (per cent)			Time from begin- ning of test	Loss in weight by evaporation (per cent)		
	Leaves attached	Leaves removed			Leaves attached	Leaves removed	
		Stems and leaves mixed	Stems and leaves cured sepa- rately			Stems and leaves mixed	Stems and leaves cured sepa- rately
96 hours.....	51.0	50.6	58.3	288 hours.....	70.9	69.8	71.9
192 hours.....	70.9	70.4	71.9				

In this case the lot with leaves attached and the lot with leaves removed but mixed in curing lost moisture at almost the same rate, while the lot with leaves removed but with stems and leaves cured separately lost moisture considerably more rapidly. This in part may have been owing to the fact that the separated material was spread out more, thus giving greater opportunity for drying.

TESTS AT BARD, CALIF.

A similar though somewhat simplified experiment was conducted at Bard, Calif., in September, 1924. At this time of the year the alfalfa is often not very vigorous, and some difficulty was encountered in procuring satisfactory samples. The plants were nearly in full bloom. As the weather was very hot and dry, the plants lost moisture so rapidly that the weights were practically at a standstill after two days. Samples were dried in the shade and in the sun to ascertain the comparative rate of curing under these different conditions. The results are shown in Table 7.

TABLE 7.—*Comparative losses in weight of 100-gram samples of alfalfa in process of curing in the shade and in the sun, with leaves attached and with leaves removed, at Bard, Calif., in September, 1924*

Time from beginning of test	Loss in weight by evaporation (per cent)			
	Leaves attached		Leaves removed	
	In sun	In shade	In sun	In shade
2½ hours.....	47.0	28.0	45.0	30.0
17½ hours.....	67.0	65.0	66.6	67.5
49½ hours.....	74.5	74.3	72.3	73.0
68½ hours.....	74.2	74.6	72.5	73.2

In this test there appeared to be no appreciable difference in the rapidity with which moisture was lost whether the plants were dried with the leaves on or off. As might be expected, the plants dried in the sun lost moisture much more rapidly in the first few hours. At the end of 17½ hours, however, the samples dried in the shade had lost equally as much.

Similar results were obtained in a second test with 100-gram samples at Bard, Calif., in December, 1924. (Table 8.) Contrary to other tests, the stems in this case seemed at first to lose moisture more rapidly than the leaves. In other respects the results correspond closely with those previously reported, in that the alfalfa with leaves attached lost moisture less rapidly than with leaves removed.

TABLE 8.—*Comparative losses in weight of 100-gram samples of alfalfa in process of curing, with leaves attached and with leaves removed, at Bard, Calif., in December, 1924*

[Each result is the average of two samples]

Time from beginning of test	Loss in weight by evaporation (per cent)				Time from beginning of test	Loss in weight by evaporation (per cent)			
	Leaves attached	Leaves removed	Leaves only	Stems only		Leaves attached	Leaves removed	Leaves only	Stems only
14½ hours.....	18.5	19.5	16.4	20.8	71 hours.....	54.0	59.0	61.5	54.2
16½ hours.....	21.3	22.3	19.5	23.8	86 hours.....	57.0	63.5	67.3	57.1
18½ hours.....	25.5	26.8	24.8	26.8	95 hours.....	60.0	65.5	69.0	59.5
20½ hours.....	27.0	29.3	27.5	29.3	110 hours.....	62.0	66.0	69.5	60.1
22½ hours.....	29.0	31.3	29.5	31.5	119 hours.....	62.5	66.8	69.9	61.3
38 hours.....	40.5	44.3	43.8	42.9	134 hours.....	65.5	67.8	69.9	63.7
47 hours.....	47.0	48.8	48.7	47.0	143 hours.....	66.0	67.8	69.5	64.3
62 hours.....	52.3	55.0	56.6	51.2	158 hours.....	66.0	67.0	69.0	63.1

TEST AT ROSSLYN, VA., NEAR WASHINGTON, D. C.

Early in November, 1924, 3-ounce samples of alfalfa were collected at Arlington Experiment Farm, Rosslyn, Va., and dried in the office at Washington, D. C. As the crop had been cut two weeks previously the alfalfa was only 8 inches high and far from mature when the samples were taken. This accounts for the high percentage of moisture in these samples as compared with most of the samples previously described. The results are shown in Table 9.

TABLE 9.—*Comparative losses in weight of 3-ounce samples of alfalfa in process of curing, with leaves attached and with leaves removed, at Washington, D. C., in October, 1925*

Time from beginning of test	Loss in weight by evaporation (per cent)		Time from beginning of test	Loss in weight by evaporation (per cent)	
	Leaves attached (average of 3 samples)	Leaves removed (average of 4 samples)		Leaves attached (average of 3 samples)	Leaves removed (average of 4 samples)
½ hour.....	3.48	4.70	67½ hours.....	73.6	78.15
2½ hours.....	11.80	12.50	115½ hours.....	79.88	82.50
19½ hours.....	39.60	45.30	163½ hours.....	83.30	83.60
25½ hours.....	54.85	60.90	187½ hours.....	83.30	83.30
43½ hours.....	69.43	74.50			

Here, as at other points where a similar experiment was carried out, there was very little difference in loss of moisture whether the plants dried with the leaves attached or removed. The plants with the leaves removed lost moisture a trifle more rapidly than where they were left to cure in the natural state.

TEST AT NORTH RIDGEVILLE, OHIO

At North Ridgeville, Ohio, alfalfa plants were dried on screens which had previously been weighed. Before any wilting occurred the leaves were cut off just below the leaflets, leaving the petioles attached to the stems. To equalize conditions for the different lots, the stems were placed singly in rotation on the four screens. In the case of one lot from which the leaves had been stripped, the stems and leaves were allowed to dry together. In the case of the other lot, the stems and leaves were dried separately. The weight of these samples ranged from $1\frac{3}{4}$ to $2\frac{1}{2}$ ounces. The results of the experiment are shown in Table 10.

TABLE 10.—*Comparative losses in weight of samples of alfalfa in process of curing, with leaves attached and with leaves removed, at North Ridgeville, Ohio, in September, 1924*

Time from beginning of test	Loss in weight by evaporation (per cent)					Time from beginning of test	Loss in weight by evaporation (per cent)				
	Leaves attached	Stems and leaves dried separately	Leaves removed, stems and leaves dried together	Leaves only	Stems only		Leaves attached	Stems and leaves dried separately	Leaves removed, stems and leaves dried together	Leaves only	Stems only
1 hour.....	4.6	5.8	3.8	6.7	4.9	87 hours...	71.7	74.3	68.8	82.7	67.2
15 hours....	23.1	22.6	21.7	29.8	16.4	97 hours...	76.9	80.1	73.3	82.7	73.8
18 hours....	28.9	34.1	27.1	42.3	27.0	112 hours...	75.7	76.1	72.9	81.6	71.3
20 hours....	30.1	35.0	29.6	44.2	27.0	121 hours...	77.5	80.5	75.8	83.7	77.9
21 hours....	31.8	36.0	30.4	45.2	27.9	135 hours...	76.3	76.1	76.7	76.0	76.2
24 hours....	37.0	40.3	35.8	51.0	31.1	144 hours...	82.1	85.4	81.7	84.6	86.1
39 hours....	46.2	46.9	45.8	59.6	36.1	160 hours...	79.2	79.6	77.9	76.9	82.0
44 hours....	50.3	55.3	48.3	68.3	44.3	168 hours...	78.6	80.5	79.2	78.8	82.0
48 hours....	56.6	59.7	53.8	72.1	49.2	184 hours...	75.1	77.4	75.8	76.9	77.9
63 hours....	63.0	65.5	61.7	76.9	55.7	192 hours...	79.7	82.3	78.8	79.8	84.4
68 hours....	64.2	66.8	62.5	77.9	57.4						

Here again the loss in moisture was somewhat more rapid where the leaves were removed from the stems and the two dried separately. However, where the leaves were removed from the stems and the two dried together, the loss was somewhat slower than in either of the other cases. The first day after being removed the leaves lost weight much more rapidly than the stems. The high moisture content is probably due to the fact that the alfalfa had not begun to bloom and therefore was very succulent at the time the samples were taken. The unusual fluctuation in weights is probably attributable to the fact that the screens on which the alfalfa was weighed increased in weight during humid spells. With such a small sample a slight increase in weight would be considerable when figured on a percentage basis.

SUMMARY

There is a rather popular belief that alfalfa cures more rapidly when handled so as to keep the leaves in a fresh condition until the stems have lost much of their moisture. This belief rests on the assumption that so long as the leaves are not dry they continue to draw moisture from the stems.

Tests were conducted at Redfield, S. Dak.; Bard, Calif.; North Ridgeville, Ohio; and Arlington Experiment Farm, Rosslyn, Va., near Washington, D. C., comparing losses in weight of plants cured with leaves attached and with leaves removed from the stems. As a matter of fact, in every case where the leaves were picked from the stems the alfalfa dried out somewhat more rapidly than where the alfalfa was allowed to cure in its natural state. The difference was not great, and just how much of this is due to handling can not be easily determined. However, it is perfectly clear from the data that alfalfa in the quantities here used cures at least as rapidly with leaves removed as with them attached.

In one of the tests, stems with leaves attached were found to cure no more rapidly than stems with leaves removed, which is contrary to general belief. Leaves attached to the stems seemed to lose moisture just as rapidly as leaves removed from the stems. If any appreciable quantity of moisture passes through the leaves after the alfalfa is cut they should remain in a fresh condition longer.

At the beginning of the various tests, stems and leaves were almost equal in weight. This also proved to be true when the plants had reached the air-dry stage. During the intervening time the stems weighed considerably more than the leaves in most cases, because they lost moisture less rapidly.

In most cases the alfalfa lost weight at about the same rate whether the leaves and stems were dried separately or mixed. There appears to be an exception to this in the results obtained in the test at North Ridgeville, Ohio, and in one of the tests at Redfield, S. Dak.

As was to be expected, alfalfa lost moisture more rapidly in the sun than in the shade, but the comparative results from curing alfalfa with leaves attached and with leaves removed were very similar.

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